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Performance of STICS model to predict rainfed corn evapotranspiration and biomass evaluated for 6 years between 1995 and 2006 using daily aggregated eddy covariance fluxes and ancillary measurements.

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Verifying the performance of process-based crop growth models to predict evapotranspiration and crop biomass is a key component of the adaptation of agricultural crop production to climate variations. STICS, developed by INRA, was part of the models selected by Agriculture and Agri-Food Canada to be implemented for environmental assessment studies on climate variations, because of its built-in ability to assimilate biophysical descriptors such as LAI derived from satellite imagery and its open architecture. The model prediction of shoot biomass was calibrated using destructive biomass measurements over one season, by adjusting six cultivar parameters and three generic plant parameters to define two grain corn cultivars adapted to the 1000-km long Mixedwood Plains ecozone. Its performance was then evaluated using a database of 40 years-sites of corn destructive biomass and yield. In this study we evaluate the temporal response of STICS evapotranspiration and biomass accumulation predictions against estimates using daily aggregated eddy covariance fluxes. The flux tower was located in an experimental farm south of Ottawa and measurements carried out over corn fields in 1995, 1996, 1998, 2000, 2002 and 2006. Daytime and nighttime fluxes were QC/QA and gap-filled separately. Soil respiration was partitioned to calculate the corn net daily CO2 uptake, which was converted into dry biomass. Out of the six growing seasons, three (1995, 1998, 2002) had water stress periods during corn grain filling. Year 2000 was cool and wet, while 1996 had heat and rainfall distributed evenly over the season and 2006 had a wet spring. STICS can predict evapotranspiration using either crop coefficients, when wind speed and air moisture are not available, or resistance. The first approach provided higher prediction for all the years than the resistance approach and the flux measurements. The dynamic of evapotranspiration prediction of STICS was very good for the growing seasons without water stress and was overestimated by 12-34% when rainfall deficit occurred. The preliminary comparison with intra-seasonal biomass accumulation showed that the total corn biomass derived from eddy fluxes was closer to the shoot biomass predicted by STICS than to the total biomass. The root to shoot ratio predicted by STICS was higher (30-40%) than the ratio reported in the literature ($\sim$20%). Some of the parameters controlling root growth might need a better calibration. The assembled database will help us identify the areas of greater uncertainty requiring improvement.